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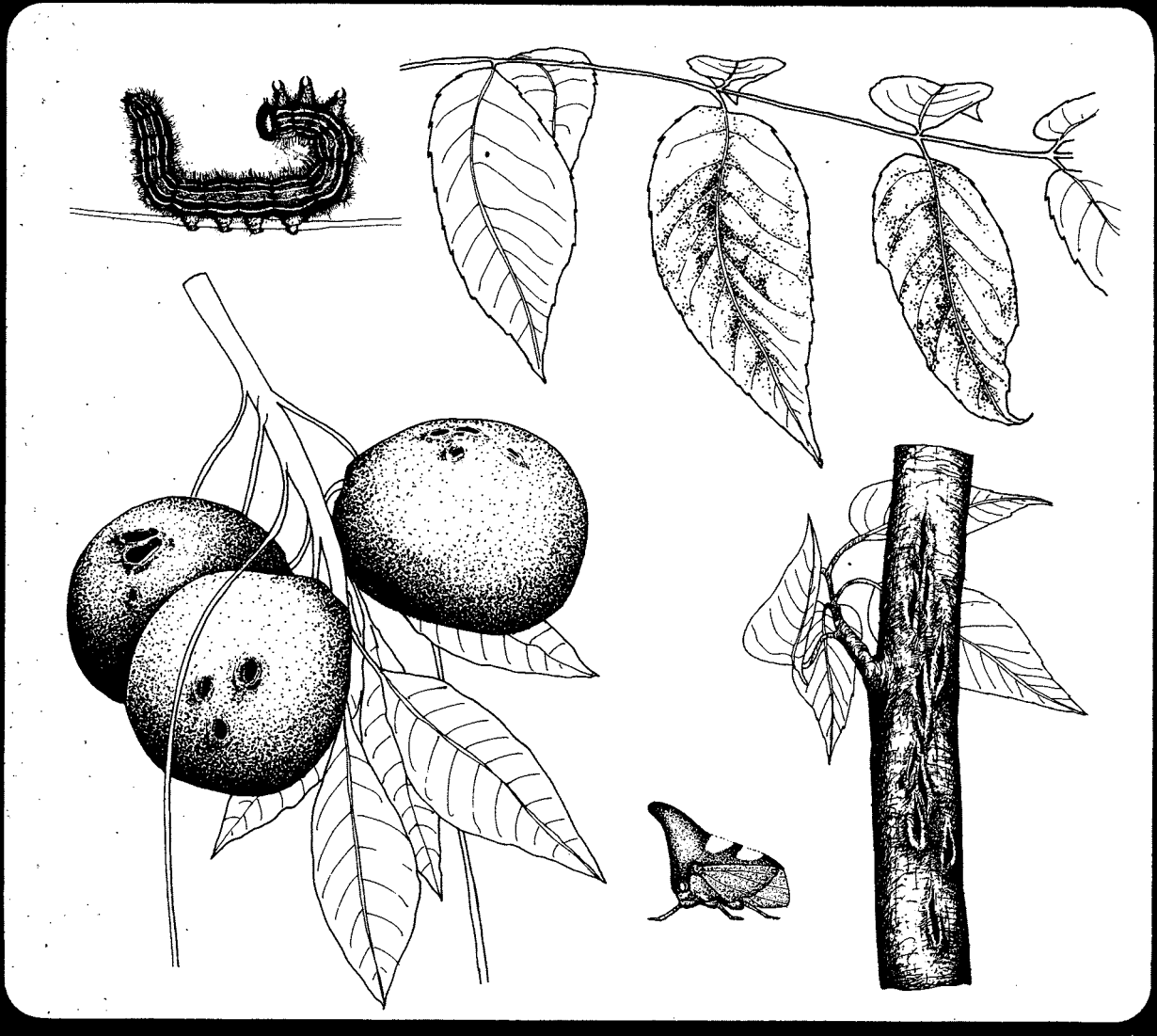
HOW TO DIAGNOSE BLACK WALNUT DAMAGE



Barbara C. Weber, Robert L. Anderson, and William H. Hoffard

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HOW TO DIAGNOSE BLACK WALNUT DAMAGE

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Black walnut trees, like all other plants, are susceptible to a variety of injuries that reduce or destroy their usefulness. The first step in preventing or controlling these injuries is to identify their cause. Most damage is caused by disease, insects, birds, mammals, or weather.

Presented here is a method for identifying the most common causes of injury to black walnut trees. It was developed primarily for use by walnut growers or foresters who are not specifically trained in insect or disease identification. The method features a "key" that leads the user step-by-step from the visual symptoms to the culprit responsible. Supplementing the key are brief descriptions of the damages and their causes, illustrated in most cases with line drawings.

Once the grower knows what is causing the problem, he can decide what can or should be done about it.

To identify all the insects and diseases that damage black walnut would be impractical and cumbersome. For example, more than 300 species of insects have been found on walnut in southern Illinois alone. So we have confined our efforts to those insects, diseases, and other sources of damage that are commonly found throughout most of the walnut-growing range and hence most likely to be encountered by the grower.

Some control measures are suggested. Generally, however, we refer the grower to the local service forester or county extension agent to find out about chemical control recommendations. This is because some chemicals currently used to control insects and diseases on black walnut may be banned or restricted by the Environmental Protection Agency in the future, thus making specific recommendations obsolete or illegal. Hence, we recommend that the grower always consult with the appropriate agencies before applying chemicals.

We have tried to keep technical terms and jargon to a minimum. Nevertheless, a few terms may still be present that are unfamiliar to some, so a brief glossary is included.

HOW TO USE THE KEY

1. **Examine the damage carefully.**
2. **Decide whether the damage is to**
   a. **foliage or nuts**
   b. **shoots, buds, or twigs**
   c. **trunk or stem**
3. **Turn to the appropriate heading in the key and work down through the alternatives.**

EXAMPLE: Yellow walnut leaf with brown spots

Select the proper category — Damage to Foliage and Nuts

Begin at A. Leaf has not been eaten, so go to B.

Read through each subheading under B.

Leaf fits description 4 ("Leaves with spots or blotches"); read through the subheadings under 4.

Damage fits the description under 4a, so it was caused by walnut anthracnose.

Compare the description and illustration of walnut anthracnose with the leaf sample.

If they do not agree, repeat the process or consult an expert.

DAMAGE TO FOLIAGE AND NUTS

A. LEAVES EATEN

1. Webbing on outer branch present in summer and early fall; webbing enlarges as season advances; caterpillars usually seen within webs. **FALL WEBWORM, p.4**
2. No webbing
   a. Caterpillars present and found in groups feeding on edges of leaflets.
      (1) Full-grown caterpillars hairy, dark purple to black, often with a white stripe along sides. **WALNUT CATERPILLAR, p.6**
      (2) Full-grown caterpillars hairy, brick red to black with yellow stripes running the body length; a yellow bar present behind the head capsule. **YELLOW NECKED CATERPILLAR, p.6**
   b. No caterpillars present
      (1) Insects rarely seen feeding; oblong holes between veins in leaflets. **MAY BEETLES, p.5**
      (2) Partially or completely eaten leaves; green or brown jumping insects may be seen. **GRASSHOPPER, p.4**

B. LEAVES DAMAGED BUT NOT EATEN

1. Young leaves drooping, later turn brown or black. **FROST DAMAGE, p.19**
2. Leaves stippled, often with some surface distortion; many dark-colored insects may be present on lower surface of leaflets, some with lacy appearance. **WALNUT LACE BUG, p.9**
3. Leaves crumpled or distorted
   a. Leaf stem or leaflets severely crumpled and distorted, especially in spring; later in the season damaged parts may turn reddish and with a velvety texture. **MITES, p.7**
   b. Leaflets cupped or moderately distorted, numerous greenish-colored 1/16- to 1/8-inch-long insects may be present on under surface of leaflets. **APHIDS, p.7**
4. Leaves with spots or blotches
   a. Leaflets pale with irregular dark brown to black spots, often bordered with yellow. **WALNUT ANTHRACNOSE, p. 15**
   b. Leaflets with white, "powdery" substance on upper surface. **POWDERY MILDEW, p.14**
   c. Leaflets with small white circular spots on under leaf surface. **DOWNY LEAFSPOT, p.14**
   d. Leaflets with regular brown spots, often with concentric rings like a "bulls eye" target. **TARGET LEAFSPOT, p.15**

C. DAMAGE TO NUTS

1. Nuts covered with small, dry, dark, sunken areas. **WALNUT ANTHRACNOSE, p.15**
2. Nuts with large, moist, dark, sunken areas. **HUSK MAGGOT/HUSK FLY, p.13**
3. Nuts with dark, crescent-shaped excavation near blossom end. **BLACK WALNUT CURCULIO, p.13**

DAMAGE TO BUDS, SHOOTS, AND TWIGS

A. EXPANDING BUDS DAMAGED, EARLY SPRING

1. Bud or expanding leaflets partially eaten; bud and elongating shoot solid, not hollowed out; insects rarely seen feeding. **MAY BEETLES, p.5**
2. Buds or expanding leaflets contain small holes; a small pile of insect droppings often present near hole; bud or shoot hollowed out; may contain drab, olive-green caterpillar with black head. **WALNUT SHOOT MOTH, p.14**

B. **ELONGATING SHOOTS DAMAGED, MID TO LATE SPRING**

1. Small, black, trumpet-shaped case attached to leaf stem; may contain drab, olive-green caterpillar with black head.
PECAN LEAF CASEBEARER, p.5

C. **SMALL TWIGS AND BRANCHES DAMAGED BY INSECTS LAYING THEIR EGGS BENEATH THE BARK**

1. Long, jagged scars, up to several inches long, on larger twigs; shredded wood fibers may be visible and hanging from scars; large red-eyed insects may be present on trees. **CICADAS, p.8**

2. Small 1/8-inch oval slits or depressions in bark of smaller twigs; small brown insects with two cream-colored spots behind a forward projecting hump may be present; insects capable of jumping.
TWO-MARKED TREEHOPPERS, p.9

3. Zipper-like slits up to 1 inch long in bark of smaller twigs; no shredded wood fibers visible. **PLANT HOPPERS, p.8**

D. **TERMINAL BUDS MISSING OR BROKEN OFF IN YOUNG TREES**

1. Main branches, especially main stem, broken and usually hanging.
BIRDS, p.19

2. Buds and young twigs nipped off; completely missing. **DEER, p.17**

DAMAGE TO TRUNK AND STEM

A. **BARK REMOVED OR HANGING IN SHREDS ON STEMS OF YOUNG TREES**

1. Bark hanging in shreds; no "teeth marks" on exposed wood. **DEER RUB, p.17**

2. Bark not hanging in shreds; exposed wood is rough with "teeth marks".
RODENT DAMAGE, p.18
(e.g. rabbits, mice, squirrels)

B. **BARK ON TRUNK SEVERELY PERFORATED**

1. Pinholes about 1/32 inch in diameter usually found in darkened, dead areas of lower trunk; may also be found in small twigs or branches; often associated with *Fusarium* canker.
AMBROSIA BEETLES, p.12

2. Holes larger, about 3/16 inch in diameter; not found in dead areas of trunk; usually form a partial to complete circle around upper trunk near branches.
BIRDPECK, p.18

C. **CRACKS OR OPENINGS IN BARK**

1. Cracks in bark depressed or flattened and darkened in areas.

   a. Usually evident near groundline on small diameter trees; tree normally dying back to depression then resprouting below dead area.
   FUSARIUM CANKER, p.16

   b. Evident around wounds or branch stubs on trees of all sizes, later developing target-shaped areas in wood; affected area enlarging each year.
   NECTRIA CANKER, p.17

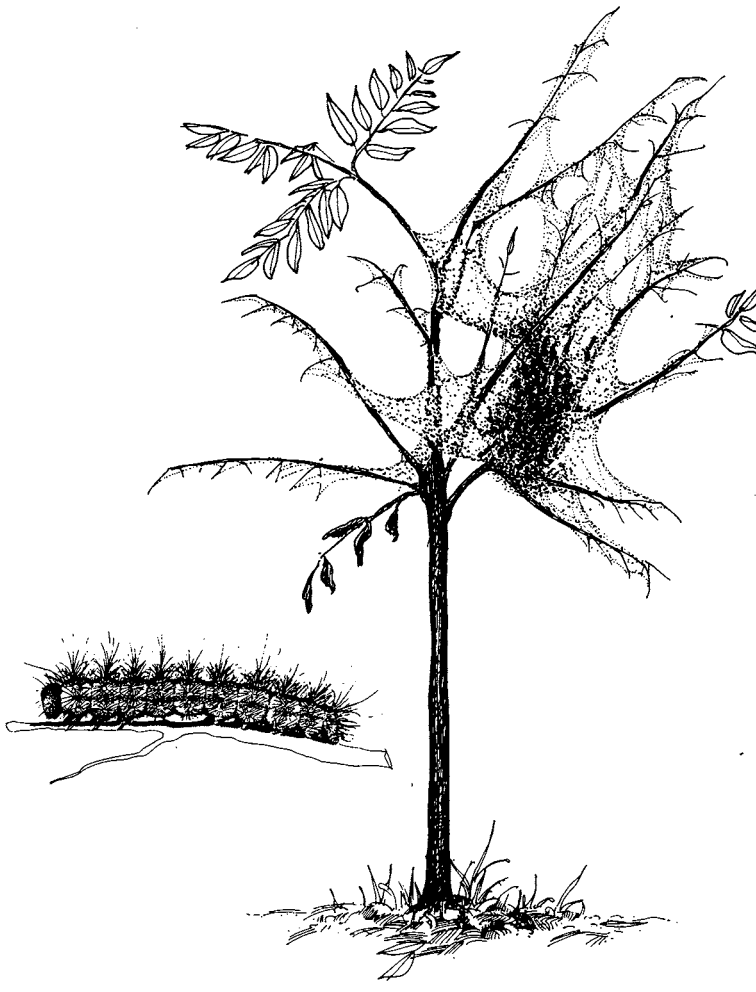
2. Cracks or openings not depressed, exposing hollow areas or unsound wood; fruiting bodies may be extruding from the tree.
DECAY, p.19

3. Bark peeling away; large tunnels in wood and bark, filled with sawdust; white, legless larvae with broad flat heads present beneath bark and in tunnels.
FLAT-HEADED APPLE TREE BORER, p.12

D. **DEAD BRANCHES IN CROWNS OF LARGER TREES;** normally an indication of root rot, poor site, herbicides, soil compaction, climatic stress, etc.
DIEBACK, p.19

DEFOLIATORS /LEAF FEEDERS

This broad category includes several different kinds of insects. All defoliators have chewing mouthparts that allow them to eat the leaves of trees and other plants. Entire trees may be defoliated. Impact of defoliation on black walnut is not completely understood but tree vigor is probably reduced, growth slowed, and the defoliated trees may become more susceptible to attack by other insects or diseases.



FALL WEBWORM,

HYPHANTRIA CUNEA (DRURY)

Description

The fall webworm is widely distributed throughout eastern United States and feeds on a wide variety of hosts. It is easily recognized by its characteristic web, which encloses one or more branches of a tree and sometimes an entire small tree. Webs begin appearing about mid-July on the outer tips of branches. As the summer progresses, the webs enlarge and become more noticeable. The larvae live inside the web, as many as several hundred to a colony. Very young larvae feed only on the cells of the upper surfaces of leaves but as they grow older they consume entire leaves. Full-grown larvae are usually pale yellow or green with a broad dark stripe down the center back and a yellow stripe down each side. The body is covered with gray or red hairs that measure about 1 inch long. The adult is a white moth with dark spots on the wings.

Injury

When the insect is abundant, whole trees may be enclosed within webs and eventually defoliated. Defoliation several years in a row may weaken the tree and slow its growth. Defoliated branches are normally not killed and will leaf out again, sometimes within a few weeks.

Control

Remove webbing and caterpillars by hand when they first become noticeable. It is not necessary to remove the branches. Repeated defoliation over several years' time may require chemical control. Consult your local county extension agent for recommended controls.

GRASSHOPPERS

Description

Several species of grasshoppers have been reported feeding on black walnut. Grasshopper nymphs and adults are green-colored insects with long hind legs designed for jumping. Adults may be as long as 2 inches.

Injury

Grasshoppers feed on leaves and are not normally considered a serious pest. However, if a walnut plantation is adjacent to an open field that is cut periodically to produce hay or some other crop, the grasshoppers may move over to the walnut trees after the field crop has been cut.

Defoliation of trees may occur when grasshopper populations are high.

Control

If possible, do not grow black walnut trees near open fields where high grasshopper populations are common. Otherwise, consult your county extension agent for recommended controls.

MAY BEETLES,

PHYLLOPHAGA SP.

Description

May beetles, also known as June beetles or June "bugs", are found throughout eastern United States.

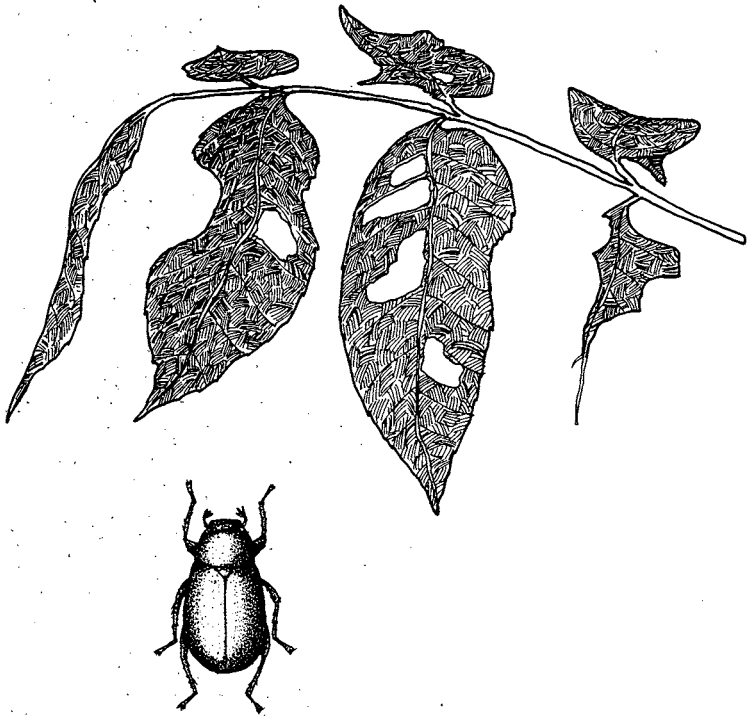
The adults are oval, robust insects that range in color from light straw to dark brown and in size from 1/2 to 3/4 inch long. The larvae, known as grubs, are milky white and C-shaped; they live underground and feed on plant roots. Adults are most often seen at night flying around lights or into windows and screens during late April, May, and June.

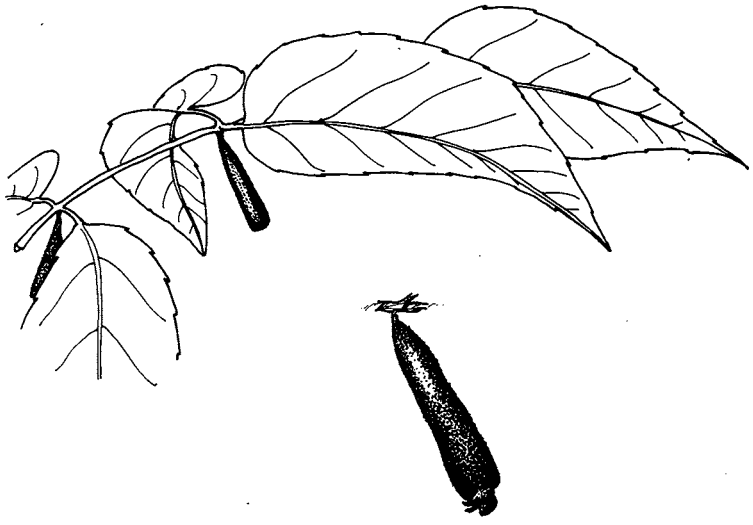
Injury

The adults feed at night on the newly expanding buds and leaflets of black walnut and other trees. Entire buds may be killed. The beetles also chew holes in already expanded leaves, causing the characteristic shot-hole effect in young leaves in early spring.

Control

Usually no control is necessary.





PECAN LEAF CASEBEARER,

ACROBASIS JUGLANDIS (LeBARON)

Description

The pecan leaf casebearer, which is closely related to the walnut shoot moth, is a much less serious pest of black walnut. Both species are commonly found in the same plantation. Because they are nearly identical in appearance, they are best distinguished by their feeding habits.

Larvae are drab, olive-green with a black head capsule. They grow to 3/4 inch long. Adults are gray-brown moths.

Newly hatched larvae overwinter in protective cases near the terminal bud. In early spring the larvae leave their cases and move to buds where they begin chewing on the outer surface of the bud scale. Feeding continues as the bud expands. A pile of excrement may conceal a feeding larva but the larva never bores inside the bud. As the larvae grow older and the leaf grows larger, the larvae move to about the middle of the leaf and construct a black trumpet- or cone-shaped case around themselves. From the case, which remains attached to the undersurface of the leaf stem, larvae feed on walnut leaflets.

Injury

A small amount of defoliation may occur in a tree heavily infested with the pecan leaf casebearer. Normally, however, these insects cause little damage to expanding buds or to leaflets.

Control

No control is recommended.

WALNUT CATERPILLAR,

DATANA INTEGERRIMA
GROTE & ROBINSON

Description

The walnut caterpillar is a common pest of black walnut trees throughout eastern United States. The larvae are gregarious, often found in masses on the trunks of trees or feeding on the foliage.

Very young caterpillars are red with grayish-white hairs covering the body. Full-grown caterpillars are as long as 2 inches and have a black body with longitudinal yellow stripes along their sides. The entire body is covered with long white hairs.

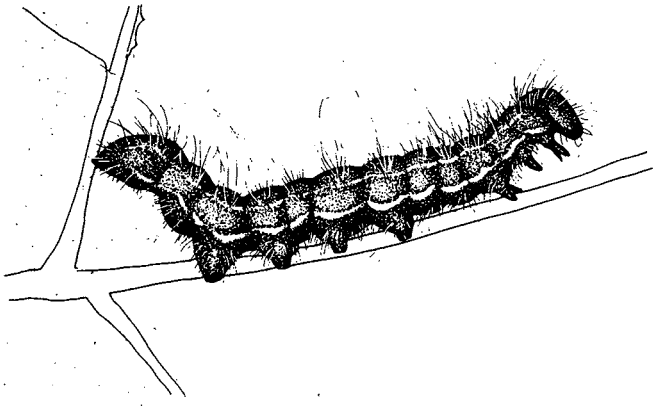
The adult moth is brownish gray and has a wingspread of nearly 2 inches. The front wings are marked by curving transverse dark lines.

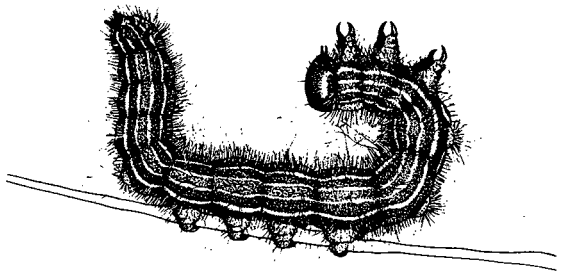
Injury

Young caterpillars eat only the outer layer of cells on the lower leaf surface; older larvae consume the entire leaf. Walnut caterpillars are gregarious and feed in colonies. One colony can defoliate an entire young tree in a short time. Often they seem to move down a line of walnut trees, stripping each of its leaves in turn.

Control

Hand removal of young caterpillars is most effective in preventing further defoliation. If this is impractical, consult your service forester or county extension agent for recommended chemical control.





YELLOW-NECKED CATERPILLLAR,

DATANA MINISTRA (DRURY)

Description

The yellow-necked caterpillar is closely related to the walnut caterpillar. It feeds on black walnut as well as other forest trees throughout most of the eastern United States.

Full-grown larvae of the yellow-necked caterpillar are about 2 inches long with a black body and black head. The "neck" area behind the head is characterized by a bright orange-yellow spot. The remainder of the body is marked with four longitudinal yellow stripes interspersed with black, and the entire body is clothed with long, soft, white hairs. The larvae are gregarious and feed in large colonies on leaves near the tips of twigs and branches.

Injury

Occasional outbreaks of the yellow-necked caterpillar may completely defoliate black walnut trees.

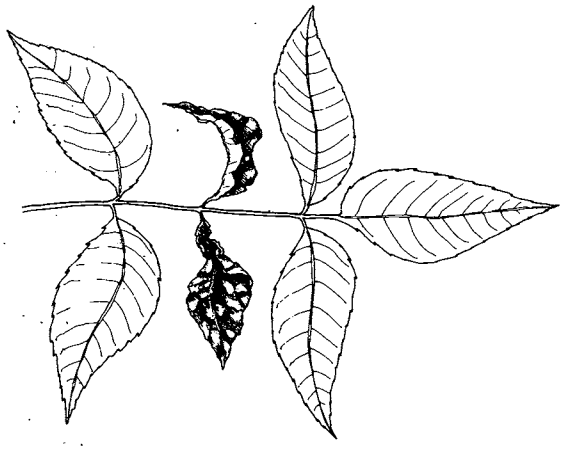
Control

When outbreaks occur, consult your local county extension agent for recommended chemical controls. Removing larvae by hand is also effective.

SUCKING INSECTS OR MITES

This category includes those insects that insert their mouthparts into a leaf or twig and suck the juices from the plant. The tree's reaction is manifested by wilted or curled leaves, galls, defoliation, branch tip dieback, or reduced growth. Determining the cause of these symptoms usually depends on identifying the insect itself.

Mites are tiny 8-legged, spider-like "bugs" closely related to insects. They have piercing-sucking mouthparts and cause damage resembling that produced by sucking insects. Expert identification is often necessary to distinguish between the two.



VELVET GALL MITE,

ERIOPHYES CAULIS KEIFER

Description

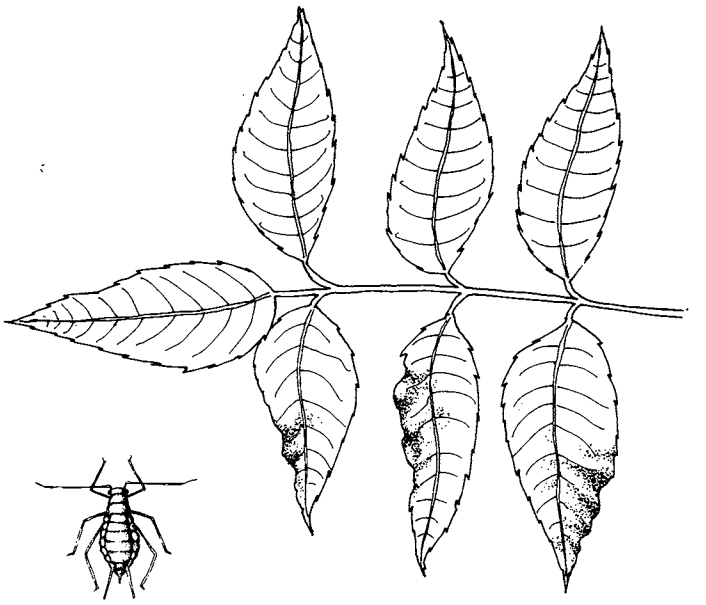
Little is known about the mites that occur on black walnut, but the velvet gall mite is common in some areas. The mite itself is so small that it cannot be seen with the unaided eye.

Injury

The velvet gall mite causes a conspicuous velvety red growth up to an inch long on the leaf stem, often causing the leaf to curl or twist over on itself. Galls may be numerous on individual trees but they are considered to be harmless to the tree.

Control

No control is recommended.



APHIDS OR PLANT LICE,

MONELLIA SP. AND *MONELLIOPSIS* SP.

Description

Several species of aphids are found on black walnut. They are a common, widely distributed insect pest and occur wherever walnut is grown. They occur throughout the growing season on the undersurface of walnut leaves.

Aphids are small, soft-bodied insects with pear-shaped bodies; they may be brown, green, white, or purple in color. Not all adult aphids have wings but when present the wings are transparent. The nymphs resemble the adults in color and shape but are smaller in size.

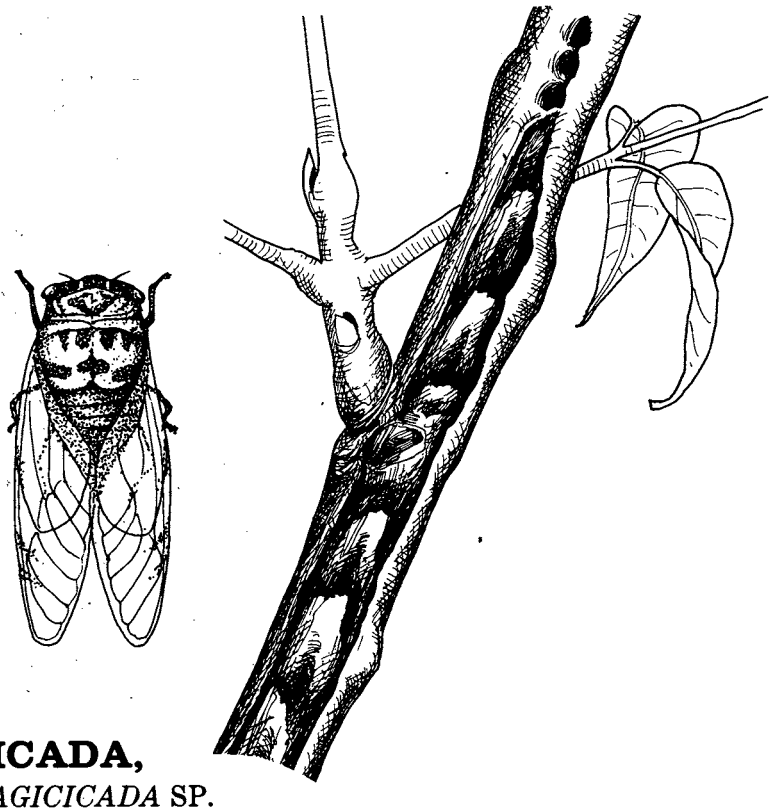
Injury

Aphids suck the juices from leaves and often deposit a sticky substance called "honey-dew" on the leaf surface. Later, the surface of the leaves may turn black in response to a fungus that grows on the honey-dew. This condition, known as "sooty-mold", may prevent light from reaching the leaf surface and thus reduce photosynthesis.

Normally, aphids are sparse on black walnut and therefore probably cause little damage. However, if conditions permit, populations can become large. Symptoms of aphid activity include curling of leaves, yellowing, defoliation, reduction of growth, and, in extreme cases, branch dieback.

Control

No control is recommended unless serious damage occurs. Then consult your local county extension agent for chemical controls.



CICADA,

MAGICICADA SP.

Description

The periodical cicada is also known as the 13-year (*Magicicada tredecassini* Alex. & Moore) or the 17-year (*M. septendecim* (L.)) locust, appearing in great numbers every 13 years in the South and every 17 years in the North. Periodical cicadas are widely distributed throughout eastern United States.

Adult cicadas are large, dark, heavy-bodied insects with membranous wings and red eyes. The females possess a strong ovipositor. Adult cicadas can reach 1-1/2 inches in length. Nymphs live in the soil, feeding on plant roots, and so are rarely seen. Adult male cicadas produce a characteristic sound by vibrating their wings against their body.

Injury

Injury to black walnut trees is caused by the adult female as she uses her ovipositor to make jagged slits in the bark and wood of twigs and small branches. Shredded wood fibers may be seen protruding from the slits. Affected twigs and branches are weakened and commonly break off in strong winds. Oviposition scars may be visible for several years after the injury was made.

Control

No controls are recommended.

PLANT HOPPERS

Description

Several species of plant hoppers have been found on black walnut, the most common of which are *Anormenis septentrionalis* (Spinola) and *Metcalfa pruinosa* (Say).

The nymphs of both species are similar in color and size. They resemble small fluffy masses of cotton because of white waxy secretions they deposit around themselves and on the plant. Adults of *Metcalfa pruinosa* are dark blue-black in color, sometimes with a white powdery substance obscuring the color. *Anormenis septentrionalis* adults are green to yellow-green. Both species are approximately 1/4 inch long and they hold their wings flat against the sides of their bodies. Plant hoppers are noted for their ability to jump when disturbed.

Injury

Adults and nymphs are sucking insects, feeding on sap taken from leaves and stems of smaller twigs. Feeding damage is considered insignificant. The female adult, however, may cause the tips of small twigs to die when she deposits her eggs in zipper-like slits beneath the bark.

Control

Control is usually not necessary.

2-MARKED TREEHOPPER,

ENCHENOPA BINOTATA (SAY)

Description

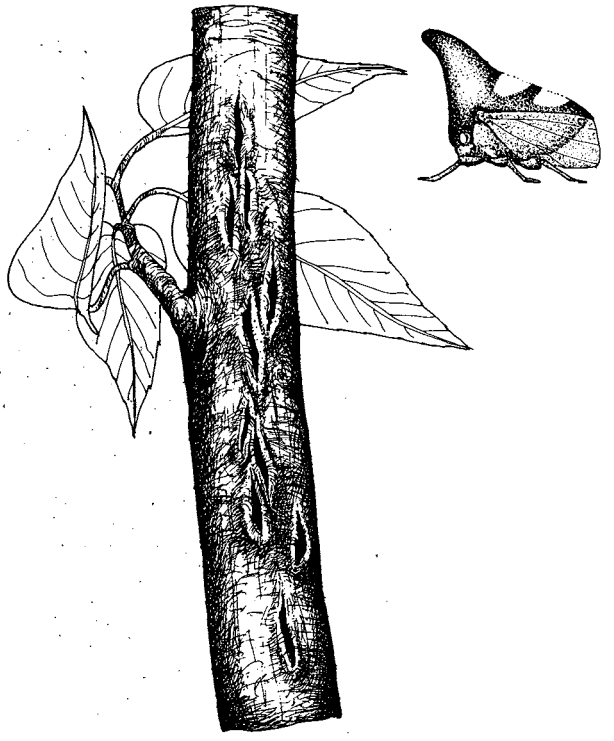
The 2-marked treehopper is a small, dark-brown insect with two yellow spots on the center of its back. It has a thorn-like projection over the head and jumps when disturbed. Adults are approximately 1/4 inch long. The nymphs are black with white markings and often have spine-like structures extending from their abdomens. Treehoppers are widely distributed throughout eastern United States.

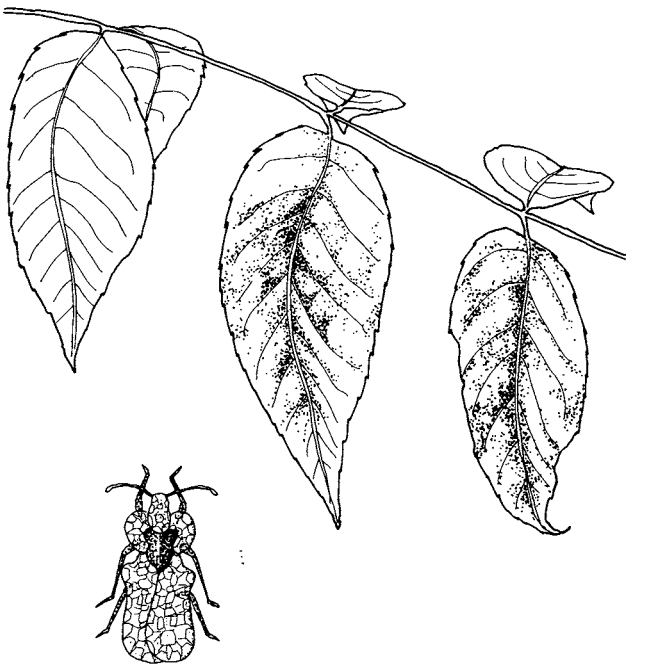
Injury

Both adults and nymphs suck sap from walnut leaves. Often they can be seen feeding on the lower leaf surface or on the leaf rachis. Although they may be abundant within a plantation, their feeding habits do not appear to cause serious damage. However, female adults can damage twigs when they deposit eggs into small slits made by their ovipositors. After the eggs are laid the female covers them with a white frothy "plug" that later turns brown. After the eggs hatch, the slits remain evident as scars for several years. Treehoppers are present on walnut trees throughout the growing season.

Control

Control is usually not necessary.





WALNUT LACE BUG,

CORYTHUCA JUGLANDIS (FITCH)

Description

The walnut lace bug feeds almost exclusively on black walnut and is found throughout the range of black walnut.

It is so named because of the adult's lacy wingcovers. The head is covered with a lace-like, arching hood. Adults are about 1/5 inch long and have transparent white wingcovers with dark bodies. The nymphs are much smaller, dark brown in color, and oval-shaped.

Injury

Both adults and nymphs are found together on the lower surfaces of walnut leaflets where they suck the sap from the leaves. More than 100 nymphs and adults may be present at one time on one leaflet. Areas where they have fed are easily recognized because of cast skins, excrement, and dark, discolored patches of leaf. The upper leaf surface is stippled with tiny white spots that give the upper leaf surface a whitish appearance. Leaves of heavily infested trees may turn brown and fall off.

Control

Consult your local service forester or county extension agent for the recommended control methods.

Velvet gall mite damage

Aphids on black walnut

Walnut caterpillar (early stage)

Weevil damage

Frost damage

Walnut caterpillar (late stage)

Two-marked treehopper

Yellow-necked caterpillar

BORING INSECTS

Some boring insects attack buds or other soft plant parts; others bore into the wood itself. Bud borers are perhaps the most serious insect pests of black walnut because they can kill terminal buds and cause multiple forking in a young tree, destroying its value for veneer or high quality timber. Insects that bore directly into wood usually attack only weakened, dying, or dead trees.

AMBROSIA BEETLES

Description

At least two species of ambrosia beetles attack black walnut trees but the most serious is *Xylosandrus germanus* (Blandf.). This beetle occurs throughout most of the northeastern and north-central walnut growing regions.

The adult female beetle is dark brown to black and about 1/8 inch long. The immature stages are rarely seen because they occur in tunnels made inside the wood by the adult female. External entrance holes to these tunnels are about 1/32 inch in diameter, and are sometimes referred to as pinholes.

Injury

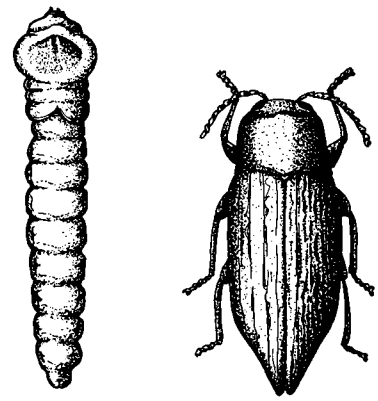
Young walnut trees up to 8 years old are most often attacked.

A *Xylosandrus germanus* female may introduce a *Fusarium* fungus into the tree as she excavates her tunnel into wood. This fungus causes a cankered area in the wood, usually causing top dieback and resprouting from the base of the tree. Cankering, however, is not always apparent. In some plantations, dieback in 1 year due to ambrosia beetle/*Fusarium* canker attack has been reported on 30 to 40 percent of the trees.

Ambrosia beetle attack is usually not detected until there is profuse sprouting from the base of the trees or until the trees are dead. Close examination is necessary to locate the tiny pinholes in the lower stem area or in small, low-hanging branches.

Control

Cut and remove dead or *Fusarium*-canker-infected tree tops and branches and burn, if possible.



FLAT-HEADED APPLE TREE BORER,

CHRYSOBOTHRIS FEMORATA (OLIV.)

Description

The flat-headed apple tree borer is a common insect in the eastern United States, attacking primarily apple trees but also black walnut.

The adult beetle is flat with a dark-green bronze back and a metallic brassy color on its abdomen. The body is bullet-shaped, ranging in length from 1/3 to 2/3 inch. The wing covers are usually marked with two, wavy, depressed, light-colored bands.

Full-grown larvae have flat, broad heads and yellowish white bodies about 1 inch long.

Injury

Adults feed on the foliage of trees but the larvae feed in the phloem and outer sapwood area. They make large tunnels, sometimes several inches long. The flat-headed apple tree borer often attacks newly planted trees or trees weakened or stressed by drought, defoliation, or disease, thus hastening the tree's decline.

Control

Maintain tree vigor by pruning dead or diseased branches and fertilizing the soil if nutrients are limiting. Wrap trunks with high-grade wrapping paper or burlap when trees are planted or pruned to prevent female beetles from laying eggs.

WALNUT CURCULIO,

CONOTRACHELUS RETENTUS (SAY)

Description

The walnut curculio is commonly found throughout eastern United States wherever walnut trees are grown.

The adult curculio is about 1/5 inch long and is reddish-brown with two small, white spots on its wing covers. It has a long snout with which it feeds. The larvae are small, legless, and a dirty white in color.

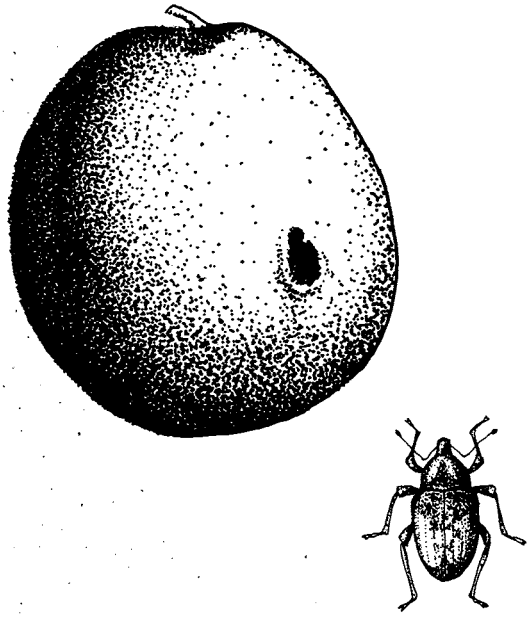
Injury

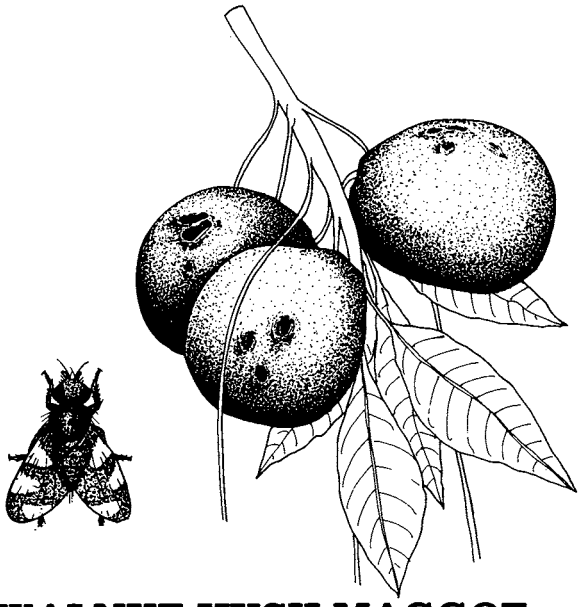
The adult female curculio lays eggs in young nuts in May, June, and July. The larvae bore into the developing nuts and cause great losses during the so-called "June drop" of walnuts. Walnut curculio larvae also cause the meager filling of walnuts that remain on the tree. A small exit hole in the side of a fallen nut is evidence that walnut curculio larvae have been present.

Walnut curculio has caused losses of 60 percent or more of the nut crop.

Control

Consult your local service forester or county extension agent for recommended chemical control. If you have only a few trees, immediately pick up and discard any immature nuts that fall during the growing season.





WALNUT HUSK MAGGOT,

RHAGOLETIS SUAVIS (LOEW) AND

WALNUT HUSK FLY,

RHAGOLETIS COMPLETA CRESSON

Description

The walnut husk fly and the walnut husk maggot both occur commonly throughout central United States.

The walnut husk fly and the husk maggot look alike. They are light brown in color and have two transparent wings with dark cross bars. They are smaller than the house fly. The larvae of both species are legless and pale yellow in color. Full grown larvae are up to 1/2 inch long.

Injury

The walnut husk fly and the walnut husk maggot breed and lay eggs in the husks of nearly mature walnut fruits in early autumn. The larvae burrow into and feed on the husk, producing black, slimy husks that stain and stick to the shell. The maggots can sometimes be seen crawling in the husks.

Husk maggots and husk flies do not penetrate into the nut, so the taste and color of the nutmeat are not affected. However, the slimy nature of the husks reduces their value to commercial nutmeat producers because the husk is difficult to remove. The infested husks also make the nuts unattractive and undesirable to the private walnut grower.

Control

Pick up and remove infested walnuts from the plantation as soon as possible after they fall from the trees. Contact your county extension agent for recommended controls.

WALNUT SHOOT MOTH,

ACROBASIS DEMOTELLA GROTE

Description

The walnut shoot moth is closely related to the pecan leaf casebearer, also an insect pest on black walnut. They are nearly identical in appearance but habits differ and serve to differentiate the two species.

Larvae of the walnut shoot moth are drab, olive-green with a black head capsule. They reach a length up to 3/4 inch. Adult moths are gray-brown with a small white patch on each front wing.

Newly hatched larvae overwinter in protective cases near the base of the terminal bud. In early spring each larva leaves its overwintering case and bores into the still unexpanded bud. Evidence of attack is indicated by a small pile of excrement and webbing deposited near the entrance hole.

Injury

Many terminal and lateral buds are killed, causing multiple forks and crooks in the main stem. If the attacked bud is not killed immediately, the stem of the expanding leaf is usually hollowed out and subject to breakage during high winds.

Control

Contact your county extension agent for recommended controls.

FOLIAGE OR LEAF SPOT DISEASES

Leaf spot diseases commonly occur on black walnut and other kinds of trees. They are caused by species of fungi that produce yellow, brown, or black spots on the leaves. Defoliation usually follows as the disease progresses. Foliage diseases are considered to be less serious than other types of diseases in black walnut because defoliation normally occurs late in the growing season. However, defoliation reduces growth and resistance to other stress factors.

DOWNY LEAFSPOT,

MICROSTROMA JUGLANDIS (BERANG.) SAC.

Description

Downy leafspot, also known as white mold, is characterized by small, white fuzzy areas on the lower surface of walnut leaves and pale yellow spots on the upper surface. The white fuzzy areas often fuse together so that almost the entire lower leaf surface may appear to be covered with a white powder.

Injury

The disease is of little significance because it does not kill the leaves or cause defoliation.

Control

No control is recommended.

POWDERY MILDEW,

MICROSPHAERA ALNI DC. EX WINT.

Description

Powdery mildew is a common disease on many plants and is caused by many different, closely related species of fungi.

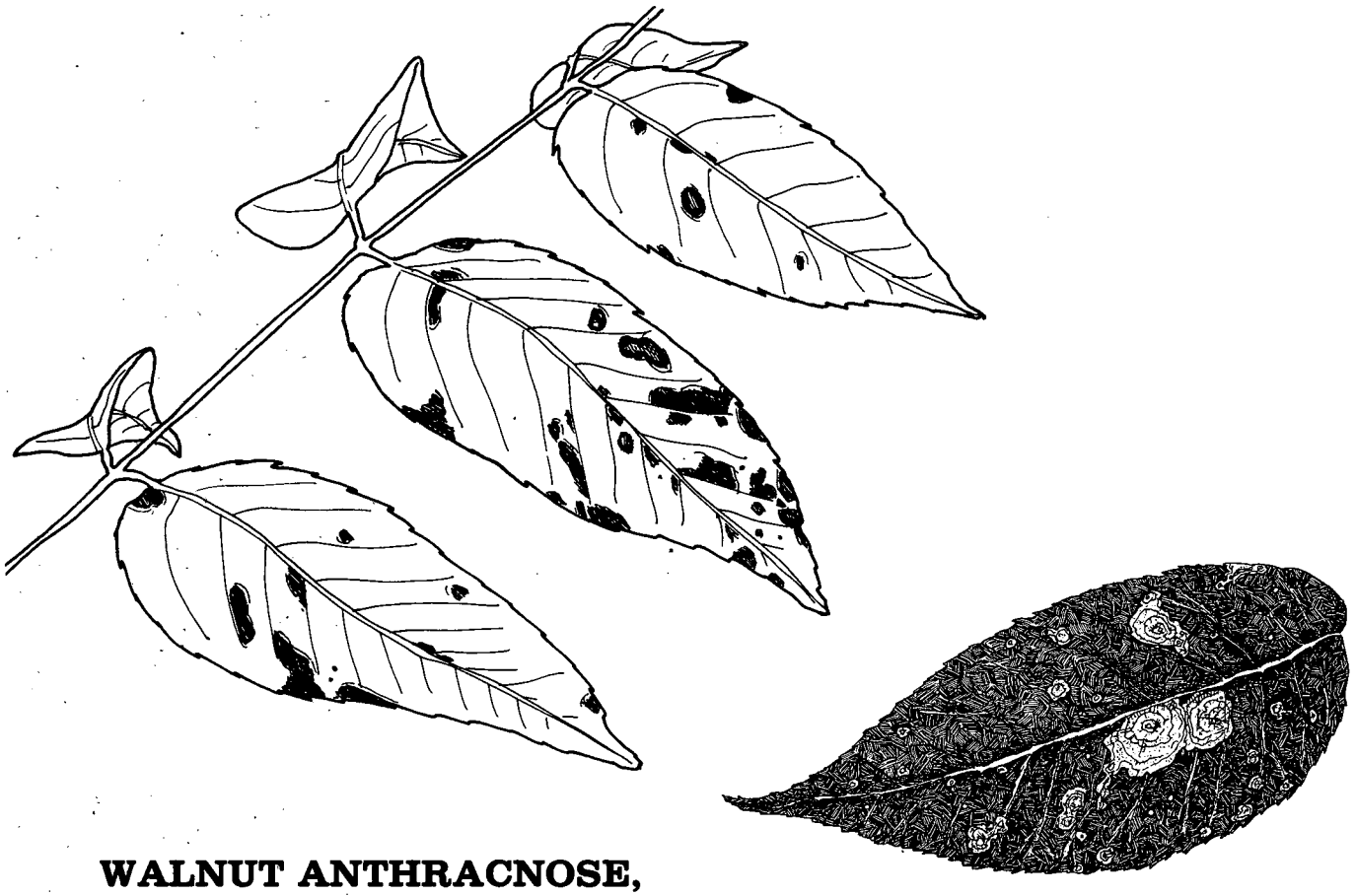
The fungus attacks leaves, buds, and young shoots covering diseased parts with a white powdery-looking mass of spores. The disease develops best in warm weather and humidity.

Injury

Heavily diseased leaves may shrivel up and turn brown. However, its occurrence on black walnut is rare.

Control

No control is recommended.



WALNUT ANTHRACNOSE,

GNOMONIA LEPTOSTYLA
(FR.) CES. & DE NOT.

Description

Walnut anthracnose is the most common leaf spot disease of black walnut and occurs wherever black walnut is grown.

The fungus causes small dark brown to black circular spots up to 1/2 inch in diameter on the leaves. These spots are usually bordered with yellow. Wet spring weather is ideal for the development of the disease, although symptoms may not become visible until June or July.

Injury

By mid-August leaves on trees infected with walnut anthracnose begin to turn yellow and drop. The growth rate of mildly to heavily infected trees is reduced. Heavily infected trees may be completely defoliated. Trees are not killed by the disease unless they are under stress from other causes. Anthracnose may also affect the quality of the nuts.

Control

Contact your service forester or county extension agent for recommended control. Fertilization with nitrogen may help reduce the harmful effects of this disease.

TARGET LEAFSPOT,

CRISTULARIELLA PYRAMIDALIS
WAT. & MARSH.

Description

Target leafspot, also known as bull's eye or zonate leafspot, is a recently discovered disease on black walnut. So far it has been reported on black walnut only in Illinois and Ohio.

The disease causes characteristic circular spots on the foliage with dark brown concentric rings inside each spot. These spots strongly resemble small targets, hence the name.

Injury

The disease progresses rapidly in black walnut. The leaf spots fuse together, causing an entire leaf to curl up, turn brown, and fall from the tree. Symptoms first appear early in August. Within only a few weeks the entire tree may be defoliated.

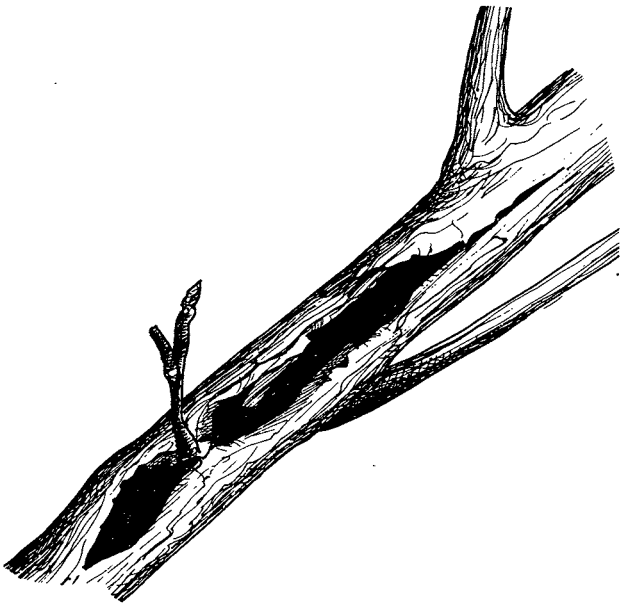
The disease causes premature defoliation, thus reducing the tree's growth, vigor, and resistance to other stress factors.

Control

No control has yet been developed. Fertilization with nitrogen should help minimize some of the harmful effects.

CANKER DISEASES

Cankers are defined as localized regions of dead plant tissue, or necrosis, in the bark of stems or branches of trees. Several different species of fungi cause cankers. Some cankers develop slowly over a period of several years whereas others grow rapidly once a tree has been infected. Cankers often completely girdle the stem, killing the tree. They are serious diseases and difficult to control.



FUSARIUM CANKERS,

FUSARIUM SP.

Description

Several species of *Fusarium* are known to cause cankers in black walnut in the Midwest and North Carolina. Trees in other States are also probably affected by the canker.

Elongate cankers of various lengths usually occur on the lower portions of the main stems of young trees, near the ground line. However, cankers may also occur higher on the stem or on branches in the lower crown of young trees. Cankers first appear as breaks in the bark or as expanding sunken areas. Darkly stained, diseased wood can be found beneath the bark. An affected tree often produces sprouts near the canker or at the base of the stem. Sometimes tiny pinholes caused by an ambrosia beetle can be found within the cankered area.

Injury

Affected trees show cankered, stained areas on the stems. An otherwise normal-looking tree that is producing many basal sprouts is commonly cankered. The primary injuries caused are wilting of leaves and dieback of the top. When the top has died, a sprout may take over and replace the lost tree, but several years of growth are lost.

Control

Cut and remove diseased trees from the plantation. Prune dormant trees and burn or remove pruning debris from the area.

PERENNIAL TARGET CANKER,

NECTRIA GALLIGENA BRESS.

Description

Perennial target canker, also known as Nectria canker, occurs on black walnut throughout its range, but seems to be more common in the Northeast and the southern Appalachians.

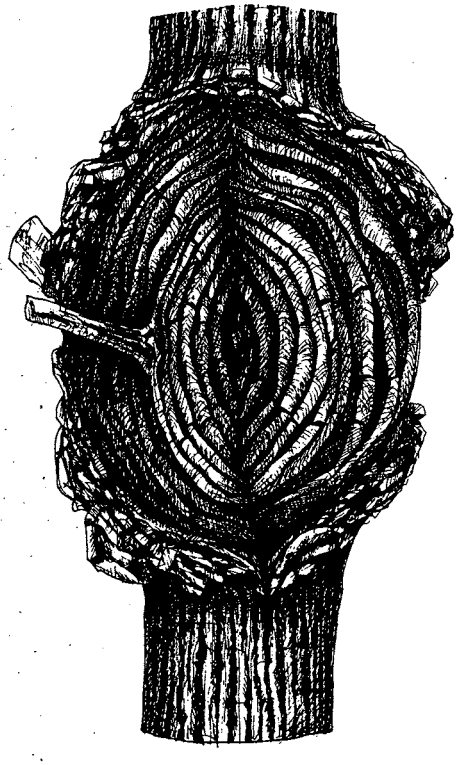
Old cankers are easily recognized because of their typical target shape, caused by rings, each of which represents a year's growth of callous tissue around the infected area. Young cankers are not as easily recognized because overgrown callous tissue may hide the affected area. Tiny, red fruiting bodies of the Nectria fungus may be present around the diseased area.

Injury

Cankers usually occur on the main stem of the tree, often at a point where a branch broke off and left an open wound. Nectria canker results in defects in the wood, stunting of growth, or death (if the canker becomes large enough to girdle the stem). Trees may also break at canker locations during high winds.

Control

Cut infected trees and remove from the area, including other tree species that may also be affected: yellow birch, sassafras, paper birch, northern red oak, red maple, beech, and bigtooth aspen.



MAMMAL DAMAGE

Deer, squirrels, mice, rabbits, and beaver are the most common and destructive. Types of damage caused include nipped buds, gnawed or shredded bark, girdled stems, reduced nut crop, and stolen nuts that had been planted for trees. Loss of growth, severe forking, or death are the final results of mammal damage.

DEER DAMAGE

Description and Injury

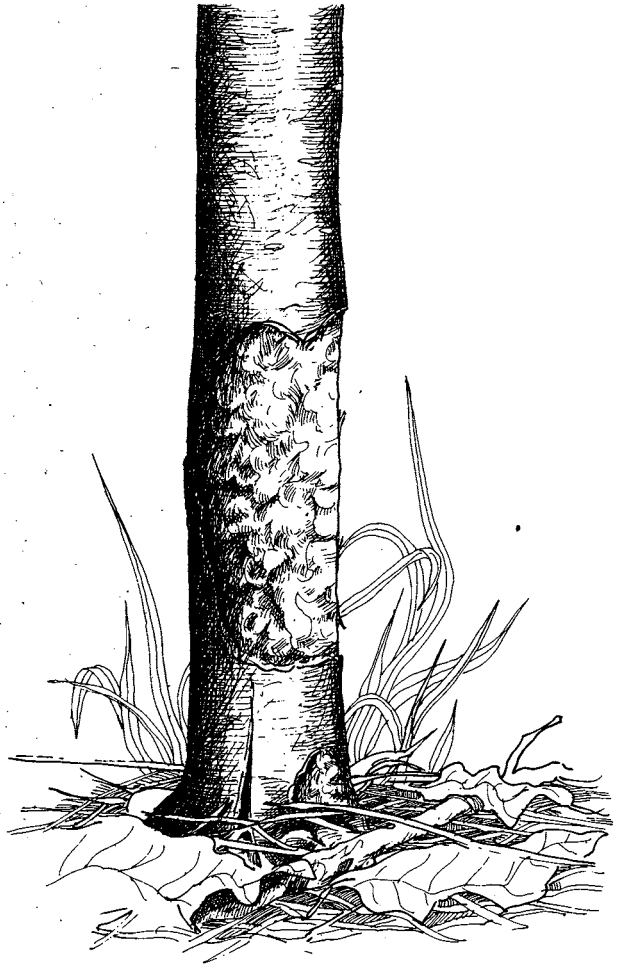
Buck deer rub against young black walnut trees in the fall to remove the velvet from their antlers, often shredding the bark and leaving it hanging in strips. Larger trees, more resistant to bending, are usually not affected.

Deer may also nip the buds of smaller trees, causing forking of the main stem. In areas of high deer populations, tree growth may be stunted because terminal buds are eaten by deer every year.

Control

An effective, but expensive, means of preventing deer damage is to erect a tall fence around the entire plantation.

Another suggested but not proven means of control is to hang cloth bags containing tankage (dead animal residues, obtainable from slaughter houses) on every second or third tree around the periphery of the plantation.



RODENT DAMAGE

Description and Injury

Mice, rabbits, and other small mammals gnaw on the stems of young trees, usually during winter, and remove patches of bark. Teeth marks are usually visible at the base of the tree.

Squirrels are a common problem in black walnut. Walnuts are a favorite food of squirrels, which feed on green nuts still hanging on the tree or mature nuts after they have fallen. Squirrels also dig up planted walnut seeds, sometimes destroying entire plantations seeded directly with nuts.

Control

Wire screening around the base of young walnut trees will prevent small rodents from eating the bark.

Commercial animal repellents seem to have little or no effect on squirrels. The most effective control known to date is to place *fresh* cow manure on top of each newly planted nut.

OTHER

This category includes all other factors that may damage black walnut, e.g., frost, birdpeck and other bird damage, decay, flooding, herbicides, mechanical damage, unexplained dieback, or any other type of damage for which the exact cause is not known. Generally, there are few control measures. The best solution is to prevent initial damage to the trees by following recommendations for site selection and care of the trees.

BIRDPECK

Description

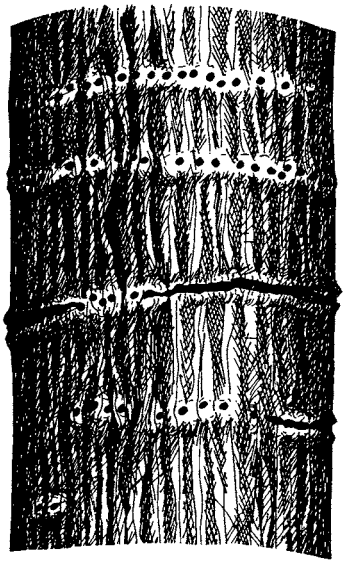
Birdpeck is caused by the yellow-breasted sapsucker, *Sphyrapicus varius*. Damage to black walnut normally occurs during late winter or early spring when sap is flowing on warm days. The sapsucker feeds directly on the sap and not on insects. It may drill test holes into several different trees. Once a favorite tree is found, the bird usually returns to that tree often until it may be nearly girdled with peck holes.

Injury

Holes made by the sapsucker normally heal over quickly but they cause defects and stain in the wood, reducing the value and quality of products made from it.

Control

No control measures are known at this time.



BIRD DAMAGE

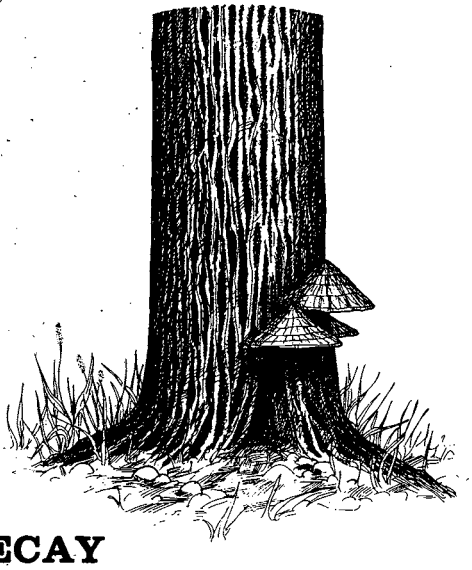
Description and Injury

Breakage of the main stem of young black walnut trees by perching birds has occasionally been reported. Red-wing blackbirds and owls are the birds most commonly seen in association with this type of damage.

The main stem of the tree or branches are broken but usually remain hanging on the tree.

Control

Erecting several tall poles at various places within the plantation may provide the birds with more desirable perches than fragile young trees.



DECAY

Description and Injury

Decay here refers to any soft, spongy, unsound, hollow, or open area in the bark of a tree that appears to be rotting away. This part of the tree is dead and the decay is caused by fungi that live on dead wood. A hollow trunk or one that is decaying on the inside is not always evident from the outside.

Not all stain-producing fungi cause decay, but stain itself reduces the value of the wood.

Any mechanical- or fire-caused damage to a live tree leaves an open wound, that may be invaded by wood-decay or wood-staining organisms.

Control

Avoid any injury to black walnut trees that may allow the entrance of decay organisms. Prune trees properly and only during late fall and winter, when the trees are dormant and decay fungi are least prevalent.

DIEBACK

Description and Injury

Dieback refers to the dead branches or tips of branches in the crowns of otherwise apparently healthy trees. The cause is usually difficult to determine and may be due to poor drainage, herbicide damage, poor site, root rot, climate, flooding, disease, insects, or some unknown factor.

Control

Plant healthy trees on proper sites, provide adequate weed control, and maintain the vigor of trees by pruning dead or diseased branches and thinning out undesirable trees in crowded plantations.

FROST DAMAGE

Description and Injury

Frost damage in black walnut occurs when warm spells in spring, which cause buds to break, are followed by late frosts. This results in wilting, blackening, and death of the already expanded leaves and death to buds that were just beginning to break. The trees recover and put out new leaves, but forks and crooks often occur in young trees. Trees and plantations located in frost pockets are particularly susceptible. As trees grow taller they become less susceptible to occasional light frosts. Young trees may be stunted by repeated frost damage and tend to be bushy with many forks.

Control

Do not plant walnut trees in known frost pockets.

SOME HELPFUL PUBLICATIONS

Black, W.M., Dan Neely, and James Matteoni. 1977. How to identify and control leaf spot diseases of black walnut. 5 p. U.S. Department of Agriculture Forest Service, North Central Forest Experiment Station, St. Paul, Minnesota.

Bey, Calvin F. 1976. How to "train" black walnut seedlings. (Rev.) 4 p. U.S. Department of Agriculture Forest Service, North Central Forest Experiment Station, St. Paul, Minnesota.

Bey, Calvin F., and Robert D. Williams. 1976. Weed control in black walnut plantations. U.S. Department of Agriculture Forest Service, Research Note NC-203, 4 p. U.S. Department of Agriculture Forest Service, North Central Forest Experiment Station, St. Paul, Minnesota.

Bey, Calvin F., John E. Krajicek, Robert D. Williams, and Robert E. Phares. 1975. Weed control in hardwood plantations. *In* Herbicides in forestry Proceedings. p. 69-84. John S. Wright Forestry Conference, Purdue University, West Lafayette, Indiana.

Callahan, John C., and Robert P. Smith. 1974. An economic analysis of black walnut plantation enterprises. Purdue University Resource Bulletin 912, 20 p. West Lafayette, Indiana.

Carmean, Willard H., F. Bryan Clark, Robert D. Williams, and Peter R. Hannah. 1976. Hardwoods planted in old fields favored by prior tree cover. U.S. Department of Agriculture Forest Service, Research Paper NC-134, 16 p. U.S. Department of Agriculture Forest Service, North Central Forest Experiment Station, St. Paul, Minnesota.

Clark, F. Bryan. 1976. Planting black walnut for timber. (Rev.) Leaflet 487, 10 p. U.S. Department of Agriculture Forest Service.

Dillow, Martha K. 1975. Bibliography of walnut — supplement no. 2. U.S. Department of Agriculture Forest Service, North Central Forest Experiment Station, St. Paul, Minnesota.

Farris, Marion, and James E. Appleby. 1978. How to identify and control the walnut caterpillar. 4 p. U.S. Department of Agriculture Forest Service, North Central Forest Experiment Station, St. Paul, Minnesota.

Hoffard, William H., Eldon L. Heflin, and Robert L. Anderson. 1977. Economic impact of defects in Missouri-grown black walnut. U.S. Department of Agriculture Forest Service. Forest Insect and Disease Management Impact Survey D-19-77, 3 p.

Schlesinger, Richard C., and Calvin F. Bey. 1978. Natural improvement in black walnut stem form. Central Hardwood Forestry Conference Proceedings II, p. 389-400. Purdue University, West Lafayette, Indiana.

Schlesinger, Richard C., and David T. Funk. 1977. Manager's handbook for black walnut. U.S. Department of Agriculture Forest Service, General Technical Report NC-38, 22 p. U.S. Department of Agriculture Forest Service, North Central Forest Experiment Station, St. Paul, Minnesota.

Shigo, Alex L., Nelson F. Rogers, E. Allen McGinnes, Jr., and David T. Funk. 1978. Black walnut on Kansas strip mine spoils: some observations 25 years after pruning. U.S. Department of Agriculture Forest Service, Research Paper NE-393, 14 p. U.S. Department of Agriculture Forest Service, Northeastern Forest Experiment Station, Broomall, Pennsylvania.

U.S. Department of Agriculture, Forest Service. 1971. Unclaimed profits in black walnut. 4 p. U.S. Department of Agriculture Forest Service, North Central Forest Experiment Station, St. Paul, Minnesota.

U.S. Department of Agriculture, Forest Service. 1973. Black walnut as a crop. U.S. Department of Agriculture Forest Service, General Technical Report NC-4, 114 p. U.S. Department of Agriculture Forest Service, North Central Forest Experiment Station, St. Paul, Minnesota.

Williams, Robert D. 1974. Planting methods and treatments for black walnut seedlings. U.S. Department of Agriculture Forest Service, Research Paper NC-107, 6 p. U.S. Department of Agriculture Forest Service, North Central Forest Experiment Station, St. Paul, Minnesota.

Williams, Robert D., David T. Funk, and Rodney Nielson. 1977. Squirrels, direct seeding walnuts, repellents. Southern Lumberman 235(2920): 89-91.

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GLOSSARY

Canker. — dead area in plant tissues usually caused by disease.

Fruiting body. — the spore-bearing organ of a fungus (conk).

Gall. — swelling of plant tissue in reaction to feeding by insects or mites; usually found on leaves but may also occur on other plant parts.

Girdle. — damage that completely encircles the main stem of a tree, killing all wood above the damaged point; may be caused by cankers, bird-peck, rodent feeding, etc.

Larva. — immature, wingless stage of insects such as moths, beetles, and flies between the egg and adult stage; also sometimes known as caterpillar or "worm" (plural = larvae).

Lateral bud.— any bud on a tree other than the end one on the main stem or side branch.

Necrosis. — dead plant tissue, usually stained brown or black, surrounded by living tissue.

Nymph. — immature wingless stage of such insects as grasshoppers, cicadas, and lacebugs.

Ovipositor. — egg-laying organ or structure often extending from the posterior abdomen of female insects.

Photosynthesis. — food manufacturing process in all green plants using water, carbon dioxide, and sunlight.

Terminal bud. — usually the end bud on the leader or main stem of a tree, but may also refer to the end bud on each side branch.

Weber, Barbara C., Robert L. Anderson, and William H. Hoffard. 1980. How to diagnose black walnut damage. U.S. Department of Agriculture Forest Service, General Technical Report NC-57, 20 p. U.S. Department of Agriculture Forest Service, North Central Forest Experiment Station, St. Paul, Minnesota.

Presents a key to common insect, disease, animal, and other damages to black walnut. Also includes illustrations of many of the damage types and descriptions of the causal agents. Preventive or control recommendations are made where appropriate.

KEY WORDS: *juglans nigra*, causal agents, illustrations, descriptions, control recommendations.

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